INOVA

Working Paper
584

2014

The Late Adopter Scale: A Measure of Late Adopters of Technological Innovations

Sara F. Jahanmir
Luis Filipe Lages

NOVA School of Business & Economics
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* Sara F. Jahanmir

** Luis Filipe Lages

The authors thank Keith Goffin, Abbie Griffin, Erik-Jan Hultink, Christopher Lettl, Christian Lüthje, Jay Rogers, Bernard L. Simonin, Ray Smith, Marcos Telles, and Eric von Hippel for their comments on the early versions of this research, John Huffstot and Daved Barry for their revision and comments on this paper, Ana Catarina Fontes for her support during this research project, and participants and reviewers of the following conferences: Open and User Innovation Workshop 2012 (Harvard Business School), 9th Marketing Dynamics Conference 2012 (Tilburg University), 3rd Regional EMAC (University of Belgrade), and PDMA 2012 (Florida, US).

The authors acknowledge a research grant from Fundação para a Ciência e a Tecnologia (Portugal) and Nova Forum.

Part of this research was conducted while Luís Filipe Lages was an International Faculty Fellow at MIT Sloan School of Management.

* Sara F. Jahanmir, Nova School of Business and Economics, Universidade Nova de Lisboa, Faculdade de Economia, Campus de Campolide, 1099-032 Lisboa, Portugal.
Phone: ++ 351.21.3801.600, sarajahanmir2012@novasbe.pt

** Luis Filipe Lages, Nova School of Business and Economics, Universidade Nova de Lisboa, Faculdade de Economia, Campus de Campolide, 1099-032 Lisboa, Portugal.

Phone: ++ 351.21.3801.600, lflages@novasbe.pt, http://www.lflages.com

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Abstract

Diffusion of Innovation is a topic of interest for researchers and practitioners. Although substantial research is conducted on user categories, researchers often focus on the first half of the curve, ignoring the late adopters. We conduct two studies to measure the attributes of late adopters.

In our first study of mobile phone users, we develop the Late-Adopter Scale. We then test it on a sample of laptop users. This scale is multi-dimensional, presents nomological and discriminant validity and has three dimensions: 1) rate of adoption, 2) resistance to innovation, and 3) skepticism. Findings reveal that all three Late Adopter Scale dimensions are significantly associated with low price preference. Moreover, in both samples skepticism is associated with high preference for simple products, lower leading edge status, and lower product involvement. Discussion focuses on implications of this new scale to theory and practice of new product development and diffusion of innovation.

Keywords: *diffusion of innovation, late adoption, resistance to innovation, laggards, user categories, lag-user*

Diffusion of Innovation

Diffusion of innovation is the process of acceptance of a specific item over time by an individual linked to a social system (Rogers, 1962; Katz, Hamilton & Levin, 1963). Rogers (1962) proposes the curve of diffusion of innovation to explain the process through which an innovation is communicated over time. The curve introduces five different adopter categories, namely innovators, early adopters, early majority, late majority, and laggards. He argues that the adoption of innovation is a social process in which if an adopter talks to another potential adopter about an innovation, and if it works for the first adopter, then the second one is more likely to adopt. While building on Rogers' work, over the last five decades researchers have tended to focus on users who adopt a product very early and place an emphasis on the role of innovators as well as the majority in the diffusion of innovation (e.g. Bohlmann, Calantone, & Zhao, 2010; Dell'Era & Verganti, 2011; Iyengar, Van den Bulte, & Valente, 2011; Liao & Cheng, 2014; van Eck, Jager, & Leeflang, 2011). However, researchers also argue that the role of innovators in diffusion of innovation is overestimated (Delre, Jager, Bijmolt, & Janssen, 2010; Feder & Savastano, 2006) and that more attention should be given to the users who adopt a product later than others, as they also contribute to diffusion of innovation and can provide insights for the development of new products. Thus, research should address not only innovators but also other user categories (Mahajan & Muller, 1998; Pescher & Spann, 2013) and explore "opponent" users, as they can also have opinion leadership (Cavusoglu, Hu, Li, & Ma, 2010).

A better understanding of all user categories represented among the customers of a company might contribute to an innovation's success. Although there is extensive research regarding early adopters' behavior, there is very little empirical evidence about the second half of the Rogers' curve, namely about late majority and laggards, hereinafter referred to as "late adopters".

To our knowledge, the literature lacks a clear measure to assess late adopters' attributes but at least three important reasons justify the need for such a measurement scale. First, there is a need for a measurement tool to support existing conceptualizations of domains and findings in the field of diffusion of innovation. There are significant differences among characteristics of adopter groups (Läpple & Van Rensburg, 2011). Measuring late adopters' attributes could enable future researchers in the field and firms to speak the same language and have a clear and common definition of this category of users. Moreover, in order to address and fulfill different needs and expectations of late adopters, the first essential step is to identify them. Second, each new product launch faces new diffusion barriers. A successful product launch requires supporting activities to overcome those barriers (Talke & Hultink, 2010). The Late Adopter Scale enables firms and researchers to identiy late adopters and thus understand their reasons for late adoption regarding a certain generation of a product. Knowing those reasons prior to launch of the new generation could provide firms with insights about how to manage users' barriers to adopting an innovation. Finally, firms usually tend to focus on the first half of the diffusion of the innovation curve, thereby missing the inputs of the other groups of users. For example, if manufacturers knew that a set of late adopters existed for a specific generation of products, they could concentrate on satisfying this target market as early as the research and development stage of the next generation. They could establish priorities in their new product development (NPD) process by listening to the previously ignored voices of these unsatisfied users. Moreover, by identifying late adopters' characteristics, firms may also speed up product penetration.

Measurement of Late Adoption and the Late Adopter Constructs

In order to develop a measurement scale to assess characteristics of late adopters we focus on technologies, namely mobile phones and laptops. We assess late adopters through three dimensions: 1) rate of adoption (RATE_ADOPT), 2) resistance to innovation (RES_INNOV), and 3) skepticism (SKEPT). All items were adopted from Rogers' (2003) and Moore's (2006) description of adopter categories.

The first dimension, rate of adoption, refers to the amount of time that individuals took to adopt (Rogers, 2003). Adoption over time is critical to evaluate diffusion of innovation. Through this construct we assess whether the user belongs to the group of adopters who adopt the product later than others (Uhl, Andrus, & Poulsen, 1970). The second construct is resistance to innovation, which is defined as a case of resistance to change (Bagozzi & Lee, 1999). Literature indicates that late adopters are not only resistant to change, they are also suspicious of agents of change; that is, people who promote change. Moreover, they want to be certain that an innovation does not fail before adopting it (Rogers, 2003). Finally, skepticism describes users' doubtful approach toward innovations, which in the case of late adopters is with cautious skepticism (Rogers, 2003).

Study 1: The Case of Mobile Phone Adopters

Research Setting and Survey Instrument Development for Study 1

Study 1 focuses on users of mobile phones. We conducted three stages of pre-testing. First, we refined the survey instrument and cover letter. We developed the initial survey with 184 items based on user characteristics mentioned in the work of Rogers (2003) and Moore (2006) together with other key factors from established literature in innovation. All items were in English. Next, as suggested by Churchill (1979), we refined the measures through interviews with people capable of understanding the nature of the concept being measured. Finally, we tested the survey instrument with academic judges and product users. During this stage, several judges (university lecturers in marketing, finance, and sociology) assessed the content and face validity of the items. We asked our judges to assess if items were representative of the final construct, and we conducted the final revision of the survey according to their comments.

To assess informants' proper understanding of the survey instrument we asked respondents to indicate their level of English (from zero to native) and those with low level of English were excluded from the sample. Respondents were also asked to assess all the items using a 5-point Likert scale (ranging from "1- strongly disagree" to "5- strongly agree"), while taking into consideration their experience with their own mobile phone.

Data Profile and Assessment of Non-Response Bias for Study 1

We collected the data with a questionnaire. The sample was selected based on the criteria of having and using a mobile phone. Aligned with earlier research (e.g. Batra, Ahuvia, & Bagozzi, 2012), we used a sample of graduate student mobile phone users of both genders (52.4% male and 47.6% female). The average respondent's age was 26 years, with 85% between 20 and 30 years old and 15% over 30. While 3.8% of the participants indicated that their families belong to the lower class, 52% of the participants belonged to middle class, 43% to upper-middle class, and 1.2% to upper class. Out of the 135 mobile phone user participants we obtain a final valid sample of 105 users with high level of English. Non-response bias is tested by assessing the differences between two random groups of respondents of completed questionnaires with regard to the means of all the variables (Armstrong and Overton, 1977). There are no significant differences between the two groups of questionnaires.

Measurement Model of Study 1

After exploratory factor analysis (EFA) using varimax rotation, in order to assess measurement reliability and validity, the 50 items were subjected to a confirmatory factor analysis (CFA), using full-information maximum likelihood (FIML) estimation procedures in LISREL 8.51 (Jöreskog and Sörbom, 1993). After CFA purification, the initial list of 50 items was reduced to a final list of nine items. A full listing of the final nine items and their scale reliabilities is included in Appendix 1.

The chi-square for this model is significant (chi-square=46.55, 25df, p=0.00553, Figure 1). Since the chi-square varies depending on sample size, we also assessed additional fit indices: the Normed Fit Index (NFI = .93), Non-normed Fit Index (NNFI = .95), the Comparative Fit Index (CFI = .96), and the Incremental Fit Index (IFI = .96).

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Insert Figure 1 about here
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Nomological and Discriminant Validity of Study 1

Nomological validity is confirmed if all constructs are significantly correlated with a certain outcome of interest. To assess nomological validity (Churchill, 1979), we test our measures with respect to low price preference $_{(LOW\_PRICE)}$ (Appendix 2). Users who are less affiliated with a product take longer to adopt it. Overload of information and/or lack of technological knowledge about the products leads to a buying decision based on the simplest rational factor: the price. Jobber and Shipley (2012) argue that setting low prices is associated with an increase in market share. Zeithaml (1988) also defends that in the absence of other indicators users take price as an indicator of quality. This, however, does not necessarily mean that the user does not have access to financial resources. It is more about willingness to allocate those financial resources to this certain product. Thus, nomological validity is demonstrated, as all three dimensions of the Late Adopter Scale are positively and significantly correlated with low price preference ($r_{(SKEPT*LOW\_PRICE)}$ = .364, p<.01. , $r_{(RATE\_ADOP*LOW\_PRICE)}$ = .340, p<.01, $r_{(RES\_INOV*LOW\_PRICE)}$ = .350, p<.01) (Table 1).

To demonstrate discriminant validity, all three dimensions must relate to outcomes of interest to show that each dimension operates somewhat independently on the selected outcome. Moreover, this demonstrates that the scale dimensions are not the same construct measured with three different scales (Churchill, 1979).

With the goal of demonstrating discriminant validity we include three outcomes in our model: product simplicity, lead-user profile and product involvement (Appendix 2). We find that there is a significant negative correlation between skepticism and product involvement ($r_{(SKEPT*PROD\_INVOLV)}$= -.402, p<.01) as well as lead-user profile ($r_{(SKEPT*LES)}$= -.224, p<.05). This might suggest that customers who are skeptical toward innovations are less involved with the products and are not at the leading edge of markets (Morrison, Roberts, Midgley, 2004). Moreover, there is empirical evidence that uncertainty has an impact on technology adoption (Ulu & Smith, 2009). On the other hand, we find a positive correlation between skepticism and product simplicity ($r_{(SKEPT*PROD\_SIMPL)}$= .313, p<.01), suggesting that being skeptical users, late adopters prefer simple products.

We also found a significant negative correlation between resistance to innovation and product involvement ($r_{(RES\_INNOV*PROD\_INVOLV)}$= -.218, p<.05), implying that users who adopt a product later than others are less interested in and involved with a product. This is complemented by a negative correlation between resistance to innovation and leading edge profile ($r_{(RES\_INOV*LES)}$= -230, p<.01), considering that users at the leading edge of markets are more involved with a product. Overall, we may conclude that dimensions of the Late Adopter Scale present discriminant validity, as all three operate independently on different outcomes.

Assessment of Common Method Bias in Study 1

Common method bias was assessed in two stages. First, to avoid common method bias in the data collection phase, respondents were not aware of the conceptual framework of interest and the purpose of the study. Items were put in sections with recoded titles, which were of neutral meaning to respondents. Moreover, common method bias was tested with a CFA containing all

the constructs of the final model (Figure 1). Poor goodness-of-fit indices indicate the absence of common method bias (NFI=.57, NNFI=.45, CFI=.59, IFI=.60, GFI=.64, SRMR=.18, RMSEA=.28).

Study 2: The Case of Laptop Adopters

Research Setting and Survey Instrument Development of Study 2

For this study we selected a new technology and focused on users of laptops. While using the findings of study 1 as a basis, a refined version of the survey instrument was applied (113 items). In this study we used the same methodology as in study 1 in order to develop and test the survey instrument. Similar to study 1, respondents were asked to assess all the items in relation with their laptop and with themselves as users of laptops, using a 5-point Likert scale (ranging from "1- strongly disagree" to "5- strongly agree").

Data Profile and Assessment of Non-Response Bias for Study 2

The data were collected with a questionnaire. For this study, a sample of laptop users, 42% female and 58% male, aged between 18 and 73 years old (mean: 29, 68% below 30 and 14% above 40) was used. 7.4% of the participants belonged to the lower class, 74.7% of the participants belonged to middle class, 16.8% to upper-middle class, and 1.1 to upper class. A final valid sample of 100 users (out of a total number of 126) was obtained. Non-response bias was tested as in study 1.

Measurement Model of Study 2

In this study items were subjected to a confirmatory factor analysis (CFA) as explained in study one. After CFA purification of the first model, the number of items was reduced from nine to seven (RI4 and SK3 excluded, Appendix 1).

The chi-square for this model is 15.54 (13df, p=0.27509). In comparison to the first model, with this sample the values of additional fit indices increased: the Normed Fit Index (NFI) = .94, Non-normed Fit Index (NNFI) = .97, the Comparative Fit Index (CFI) = .98, and the Incremental Fit Index (IFI) = .98. Figure 2 provides an overview of the standardized estimates of each item on its intended construct.

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Insert Figure 2 about here
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Nomological and Discriminant Validity of Study 2

In order to assess nomological validity (cf. Churchill, 2003) across both studies, we also tested the measures of this study with respect to low price preference $_{(LOW\_PRICE)}$ (Appendix 2). Results of this study show that all three constructs of the Late Adopter Scale are positively and significantly correlated with low price preference ($r_{(SKEPT*LOW\_PRICE)}$ = .175, p<.05. , $r_{(RATE\_ADOP*LOW\_PRICE)}$ = .263, p<.01, $r_{(RES\_INOV*LOW\_PRICE)}$ = .312, p<.01) (Table 1).

To assess discriminant validity we tested the correlations between each dimension of the model and the three outcomes mentioned in study 1 (Appendix 2). Aligned with the first study, in this study we also found a significant negative correlation between skepticism and product involvement ($r_{(SKEPT*PROD\_INVOLV)}$= -.208, p<.05) as well as leading edge profile ($r_{(SKEPT*LES)}$= -.184, p<.05). This confirms that skeptical users are less interested in getting involved with a product and do not have the characteristics of the users at the leading edge of markets (Morrison, Roberts, Midgley, 2004). Our data show a positive correlation between both skepticism and resistance to innovation and product simplicity ($r_{(SKEPT*PROD\_SIMPL)}$= .206, p<.05, $r_{(RES\_INNOV*PROD\_SIMPL)}$= .184, p<.05), confirming that users who are more skeptical and resistant to innovations prefer products that are simple to use.
As shown above, all dimensions of the Late Adopter Scale correlate with different outcomes. Therefore, the model demonstrates discriminant validity.

Assessment of Common Method Bias in Study 2

Common method bias was assessed through the two stages mentioned in study 1. First the absence of common method bias was assured as respondents were not aware of the conceptual framework of interest. Additionally, the CFA model, containing all constructs of Figure 2, presents poor goodness-of-fit indices, thus confirming the absence of common method bias (NFI=.75, NNFI=.67, CFI=.78, IFI=.79).

Research Implications and Directions for Further Research

Most of the research in Diffusion of Innovation deals with innovators, early adopters, and the majority. To our knowledge no study deals with assessing characteristics of late adopters. Results from our studies show that late adopters' attributes can be measured through three constructs. Although we cannot claim to definitively capture all dimensions of late adopters, a major step is taken in the direction of capturing these overall evaluations. By allowing for the identification of these users, we expect that the Late Adopter Scale will contribute to business literature as well as the innovation and new product development field, enabling both researchers and practitioners to take these users into consideration as a new source of valuable information.

This new scale also presents managerial implications. The dimensions of the scale give some guidance on how to better understand the needs and preferences of these users and how to improve the quality of products based on those insights. Managerial assessment of late adoption might be extremely important because it allows managers to better understand the characteristics of late adopters as well as what they value. Thus, this scale allows us to identify some of the reasons why late adopters take so long to adopt a product. Knowing the reasons for late adoption might enable firms to address late adopters in a different way, reduce their innovation adoption time, accelerate the adoption of innovations and thereby squeeze the diffusion of innovation curve. Moreover, knowing late adopters' preference for simple products should motivate firms to simplify over-engineered products, and thus offer sophisticated technology that is simple to use.

In this paper we develop a scale of late adoption while building on the diffusion of innovation theory and analyzing data from mobile phone and laptop users. Future research is encouraged to analyze characteristics of the majority as well as innovators and also to apply the

Late Adopter Scale to other industries and services. Additionally, the Late Adopter Scale might be applied as a basis to identify barriers to, as well as drivers of, diffusion of innovation.

This paper contributes to both theory and practice through the development of the Late Adopter Scale. In a market characterized by daily challenges to firms, managers need to devote special attention to user categories, while taking into consideration the similarities as well as differences among these categories.

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FIGURE 1: CONFIRMATORY FACTOR ANALYSIS MODEL OF STUDY 1
THE CASE OF MOBILE PHONE ADOPTERS

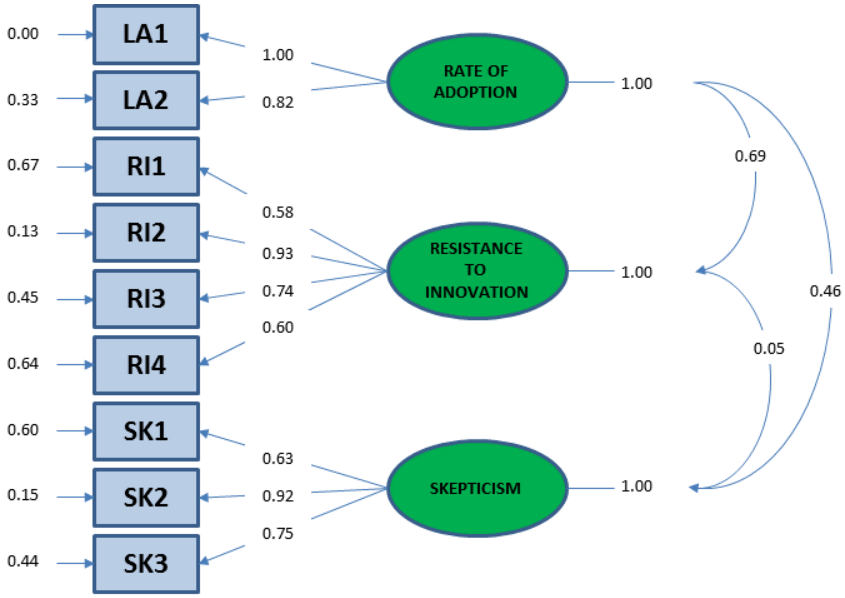
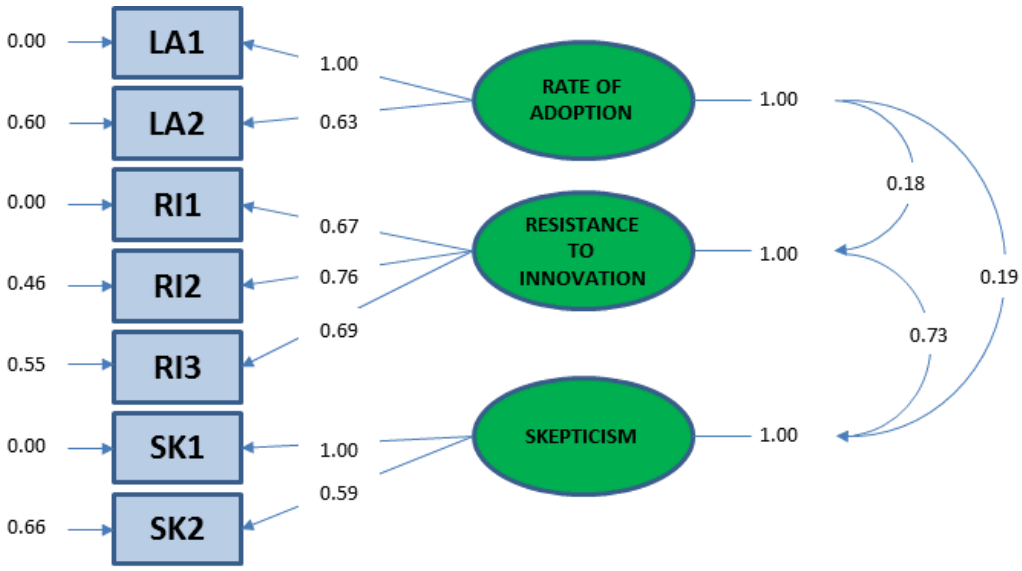


FIGURE 2: CONFIRMATORY FACTOR ANALYSIS MODEL OF STUDY 2
THE CASE OF LAPTOP ADOPTERS



APPENDIX 1
THE LATE ADOPTER SCALE

Constructs, Scale Items, and Reliabilities	
Rate of Adoption	
(Mobile: α= .92; $\rho_{vc(n)}$ = .84; ρ= .91 / Laptop: α= .70; $\rho_{vc(n)}$ = .70; ρ= .82)	
LA1	I was a very late adopter of this product.
LA2	I was one of the last to adopt this product.
Resistance to Innovation	
(Mobile: α= .72; $\rho_{vc(n)}$ = .55; ρ= .83 / Laptop: α= .63; $\rho_{vc(n)}$ = .50; ρ= .75)	
RI1	I am suspicious of agents of change (people who like change, speak with you about change, try to promote change, etc.).
RI2	I must be certain that a new idea does not fail before I adopt.
RI3	I believe resistance to innovation is entirely rational.
RI4*	My innovation decision process is relatively long.
Skepticism	
(Mobile: α= .72; $\rho_{vc(n)}$ = .55; ρ= .78 / Laptops: α= .70; $\rho_{vc(n)}$ = .67; ρ= .79)	
SK1	I approach innovations with a skeptical and cautious air.
SK2	I often fear high-tech a little bit.
SK3*	I can be stubborn in resistance to buying new products.

All scales were measured using the following 5-point Likert-scale:
1- strongly disagree; 2-disagree; 3-neither agree nor disagree; 4- agree; 5- strongly agree
*Item excluded after CFA in study 2.

APPENDIX 2

Scale Items and Reliabilities

Thinking about the product that you use, to what extent do you agree with the following sentences?

LOW PRICE PREFERENCE (Moore, 2006)

(Mobile Phone: α= .70 / Laptop: α= .55)

I prefer to buy this product when products are extremely mature and prices are cheaper.
I will not support high price margins in this sector.
I often prefer low-cost products in this sector.

PRODUCT SIMPLICITY (Inspired by Maeda, 2006)

(Mobile Phone : α= .63, Laptop: α= .80)

I like simple products.
I trust simple products.

LEAD-USER PROFILE (Inspired by von Hippel, 1986)

(Mobile Phone : α= .84, Laptop: α= .83)

In the past, I modified products myself.
In the past, I developed products myself.
In the past, I came up with new solutions for problems.

PRODUCT INVOLVEMENT (New measure)

(Mobile Phone : α= .73, Laptop: α= .70)

I am a demanding customer about this product.
I care about the product details.

All scales were measured using the following 5-point likert-scale:
1- strongly disagree; 2-disagree; 3-neither agree nor disagree; 4- agree; 5- strongly agree

TABLE 1

	Sample 1 [mobile phones]			Sample 2 [laptops]		
	Rate of adoption	Resistance to Innovation	Skepticism	Rate of adoption	Resistance to Innovation	Skepticism
Low price preference	0.340**	0.350**	0.364**	0.263**	0.312**	0.175*
Product simplicity	-0.074	0.151	0.313**	0.093	0.184*	0.206*
Leading edge profile	-0.113	-0.230**	-0.224*	0.167	0.131	-0.184*
Product involvement	-0.083	-0.218*	-0.402**	-0.123	-0.112	-0.208*

* p<0.01 (one-tailed)
** p<0.05 (one-tailed)